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# POP CORN



**P**OP CORN and field corn require the same kinds of soil and climate and the same general methods of cultivation for successful production.

The best yields of pop corn come from productive soils that are not too light or sandy and contain abundant organic matter.

The essential requirement in cultivating pop corn is to control weeds. Much of this can be accomplished cheaply by using harrows, weeders, and similar tools before or immediately after the pop-corn plants emerge.

A productive soil and thorough cultivation are even more important in the production of pop corn than of field corn, because pop-corn value depends largely upon quality, and poor growing conditions are reflected in poor quality as well as in low yield.

The production of pop corn is a highly specialized business, and profits depend at least as much upon the ability to market successfully as upon growing the crop.

Much of the pop corn of commerce is grown on contract in localized areas where facilities are available for handling it efficiently on a large scale.

Anyone undertaking production of pop corn for the general market should first assure himself that his crop can be sold if it is produced.

Small-scale production for supplying directly the needs of near-by cities and towns may be a profitable occupation for those who are especially suited to this kind of undertaking. Such a venture, however, also requires merchandizing ability to make it profitable.

This bulletin supersedes Farmers' Bulletins 553 and 554, Pop Corn for the Home, and Pop Corn for the Market.

# POP CORN

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## INTRODUCTION

THE CULTURE of pop corn almost certainly antedates the discovery of America by Columbus. Although the records are meager there is good evidence that pop corn was known and used by the Indians of both North America and South America before the coming of the white man.

The importance of pop corn as an article of commerce has developed since about 1880. The use of pop-corn confections and the rapid increase in pop-corn concessions in connection with amusement parks, moving-picture theaters, and the like has greatly increased the demand for a reliable bulk product and has made a profitable outlet for those who desire to grow pop corn on a commercial scale. In recent years the development of the small electric popper has given an added impetus to the use of pop corn in the city home. Although still largely grown in the family garden for home and local use, it is probable that with the increasing ratio of urban population and the increasing tendency toward specialization in agriculture, commercial production will become more and more important.

It is probable that pop corn is grown in every State in the Union as a garden crop to supply the home. Only a few States, however, are of importance in producing the commercial crop. Iowa is easily the leading State, with Nebraska second in production. The production in these two States has increased greatly during the 10-year period, 1921-1930, but the acreage and yield have shown wide fluctuations from year to year.

The average acreage for Iowa during this 10-year period was 25,884 acres, and the average yield was 1,606 pounds to the acre. Most of this acreage is concentrated in Sac and Ida Counties, in western Iowa. Sac County raises more pop corn than any other county in the United States and probably more than any similar area in the world. Pop-corn companies have cribs and elevators, especially designed to handle the crop satisfactorily, distributed throughout this territory.

The average acreage for Nebraska for the 10-year period, 1921-1930, was 8,600 acres, and the average acre yield 1,115 pounds. Valley

<sup>1</sup> In cooperation with the Kansas Agricultural Experiment Station, Manhattan, Kans.

County, in the central portion, has nearly two-thirds of the State acreage, and practically all commercial pop corn of the State is raised in the central and northeastern part.

#### POPPING AND OTHER QUALITIES

All starchy corns may be placed in one of the four classes—pop corn, flint corn, dent corn, or flour corn—on the basis of the distribution and relative proportions of horny and soft starch in the endosperm. The endosperm of the best strains of pop corn is corneous or hard throughout or contains only a small core of soft starch near the center. (Fig. 1.) In flint corn the endosperm consists of a small quantity of soft starch, near the embryo, completely surrounded by corneous starch. In dent corn the corneous starch is confined mainly to the sides of the kernels, soft starch constituting a larger proportion than in flint corn. In flour corn the endosperm is practically all made up of soft starch and contains only traces of hard starch.

The popping properties of the different kinds of corn follow rather closely the relative proportions of hard or corneous starch in the endosperm. Pop corn, with the greatest proportion of hard starch, is far better than the others in "poppability." Flint corn may

pop poorly to fairly well, depending on the strain. Dent corn rarely will pop, though occasionally a few kernels will pop feebly. Flour corn will not pop at all.

The popping process is due to the sudden liberation of pressure produced by steam

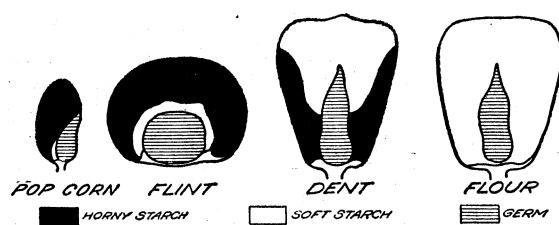
FIGURE 1.—Diagrammatic representation of location and relative proportions of horny starch and soft starch in the four main classes of starchy corn

generated within the kernel. The source of the steam is the moisture contained in the kernel. The colloidal matrix in which the starch grains are embedded within the cell confines this steam until the pressure becomes great enough completely and suddenly to rupture the original structure.

The quality of pop corn depends upon its flavor and tenderness. A large expansion during popping is closely associated with tenderness and is desirable also because it means a large volume of the finished product from a given quantity of pop corn. Popping expansion depends upon three major conditions: (1) The inherent structure of the kernels, (2) their moisture content, and (3) the proper application of heat.

Just as pop corn pops better than flint corn, so pop corn having the least soft starch in the kernels pops better than that having more soft starch. This freedom from soft starch, indeed, probably is the most important characteristic determining the popping quality of different strains.

Good expansion during popping may be expected from pop corn containing from 12 to 15 per cent of moisture, the best moisture



content being 13 to 14 per cent. The volume expansion decreases rapidly for samples having less than 11 or more than 16 per cent of moisture. Corn at these limits can be popped successfully, therefore, only if it is first treated so as to increase or decrease the moisture content. Pop corn containing too much moisture will dry rapidly if exposed to the air in heated rooms. The moisture content can be increased, on the other hand, by sprinkling very lightly with water, just enough to dampen the kernels slightly, and then storing the corn in tight containers 24 to 48 hours, or until this moisture is thoroughly absorbed. In general, pop corn stored where it is in contact with the outside air will have a moisture content suitable for popping.

In popping corn the heat should be applied evenly and neither too quickly nor too slowly. Best popping occurs when heat is applied so that popping begins in about one and a half minutes.

#### VARIETIES

Pop corn varieties may be classified into two main groups—the rice corns, which have sharply pointed kernels, and the pearl corns, which have smooth, rounded kernels. Each group contains several distinct varieties, divided on the basis of kernel color, size, and shape of ear, length of growing season, etc. Practically all varieties have white cobs. Although 50 or more varieties are listed by seedsmen and propagated in a small way by individual growers, nearly all commercially raised pop corn is of three types—White Rice, Jap, and pearl. (Fig. 2.) The main centers of production, Iowa and Nebraska, are limited almost exclusively to White Rice and Jap.

White Rice has been the backbone of the pop-corn trade; it has been used especially for pop-corn confections and concession stands and probably is still the most widely grown variety. Where well adapted, the stalks grow 6 to 7 feet tall and produce about two-thirds as many pounds of ear corn per acre as good dent corn grown on the same land. Typical ears are about 7 inches long and have 16 to 20 rows.

Jap, also known as Little Jap, Japanese, Jap Hull-less, etc., has become increasingly popular during the last few years because of its excellent popping qualities and tender texture. The plants are smaller, being on an average about 5 to 6 feet tall under good conditions, and having a characteristic thickened clublike tassel. The yield is only about two-thirds that of White Rice. The market price is usually enough higher, however, just about to compensate for the difference in yield, although the price ratio fluctuates somewhat from year to year in accordance with changes in supply and demand. Jap corn has a very characteristic short thick ear, 3 to 4 inches long, with 30 to 40 rows of kernels. Usually the rows are irregular and difficult to distinguish. The kernels are of the sharp-pointed rice type and are exceptionally long and narrow. (Fig. 3.) Many growers prefer a multiple-tipped or fasciated cob, that having three points being considered the ideal type. Practically all of the Jap corn is white, although a few growers are producing a Yellow Jap which is very similar to the white variety except for the color of the grain.

Pearl pop corn comprises a group of varieties whose commercial importance is less and whose production is less centralized than that of the two already mentioned. Queen Golden, or Golden Queen, a large yellow variety, is probably the most important of these. The plants are large and vigorous and produce good yields, but require

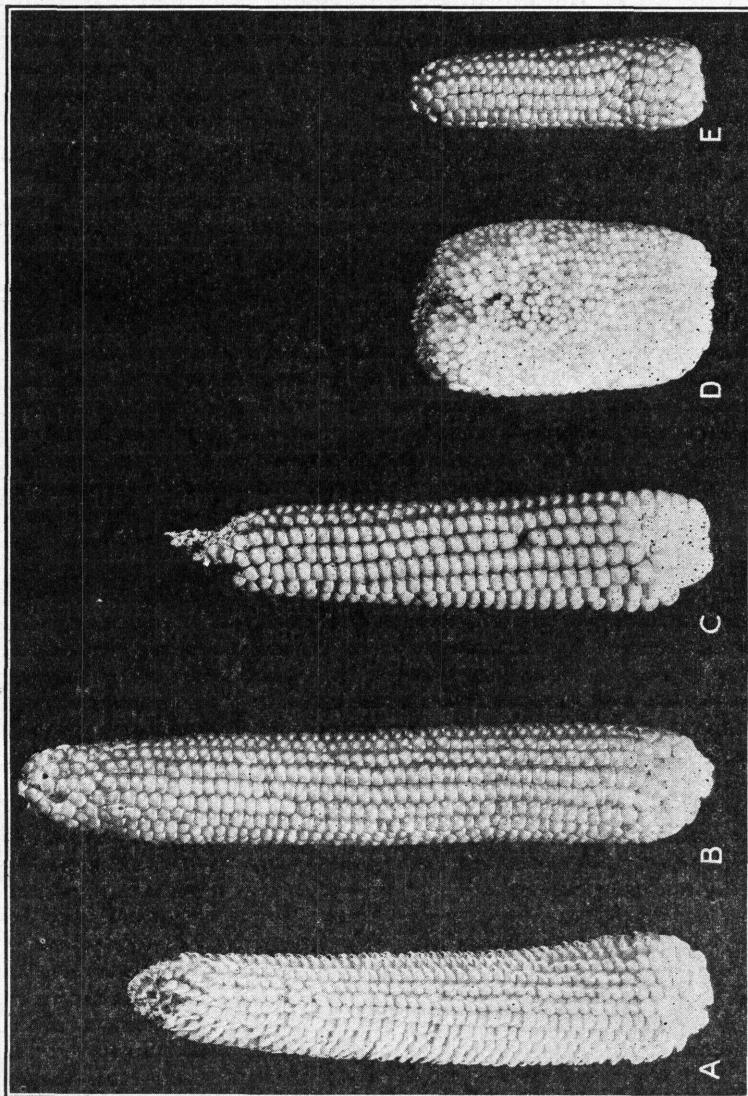


FIGURE 2.—Ears of five varieties of pop corn : A, White Rice ; B, Queen Golden ; C, South American ; D, Jap or Hull-less ; E, Tom Thumb.

a longer growing season than White Rice or Jap to mature. The popping expansion is only fair and the quality of the popped product not of the best. It is grown to a considerable extent in the southern part of the Corn Belt, where the rice types do not thrive. South American, known also as Dynamite, South African, and by a number of other names, is a variety of the yellow pearl type devel-

oped during the last few years in the Kansas City territory from a somewhat obscure origin. The original seed was supposed to have

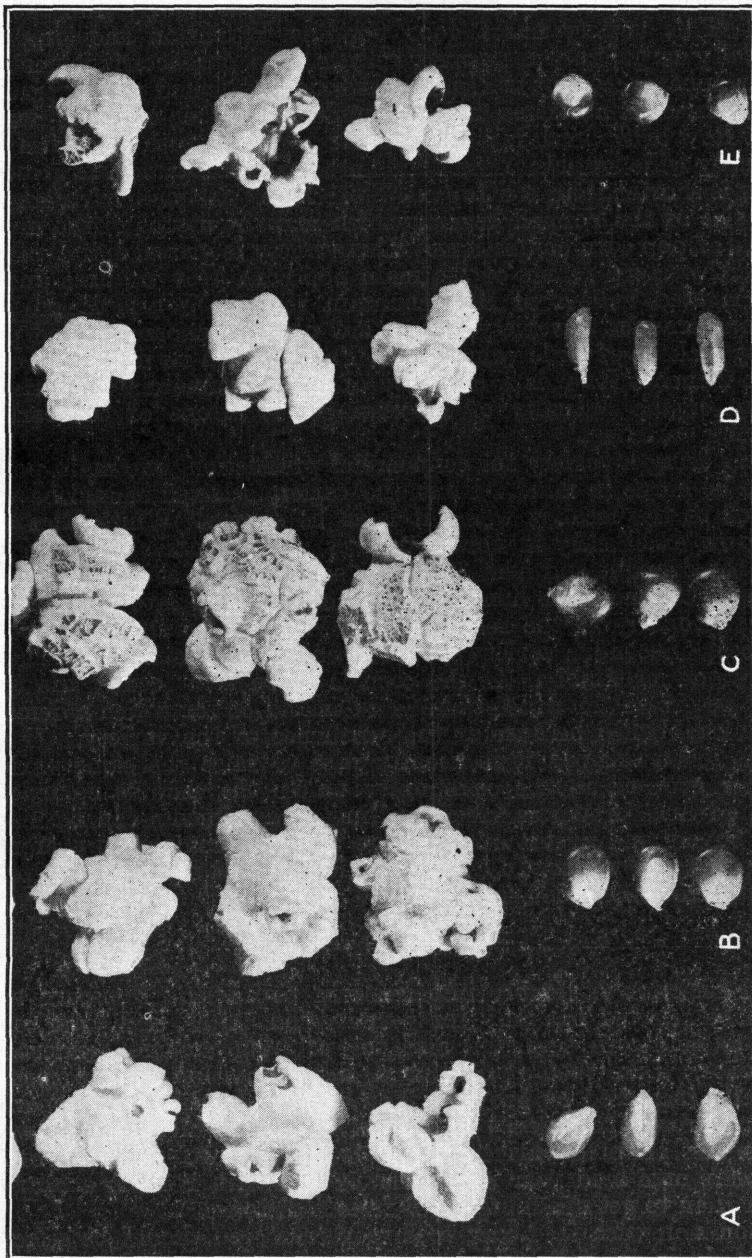


FIGURE 3.—Popped and unpopped kernels of five varieties of pop corn: A, White Rice; B, Queen Golden; C, South American; D, Jap or Hull-less; E, Tom Thumb

been imported from Argentina. The plants are of about the same maturity as Queen Golden, but have fewer suckers and produce smaller yields, especially under adverse conditions. The ears tend

to be shorter and have fewer rows than Queen Golden. Very characteristic of the variety are the large kernels with a dull lusterless appearance, and the tendency of the ears to be poorly filled at the butts. This variety has a good popping expansion and produces unusually large, round, popped kernels of a characteristic mottled yellow appearance, but has somewhat tough hulls and woody texture. It is retailed in packages and cans under a number of trade names. Eight Row or Spanish is a white pearl pop corn with few rows and unusually wide kernels. The plants are very small, and the growing season is shorter than for Jap or White Rice. Its main virtue is the large size of the popped kernels which make it useful in the manufacture of pop corn confections. This variety is grown mainly along the northwestern fringe of the main pop corn growing area and in the irrigated valleys of the mountain region. White Pearl is a vigorous productive variety, but its low popping expansion and poor quality make it of little value. Tom Thumb, with its miniature ears,  $1\frac{1}{2}$  to 2 inches long, is a curiosity of little commercial importance because of the difficulty of harvesting. It is one of the earliest maturing varieties.

In choosing a variety for commercial production, two main points should be borne in mind. First, the variety selected should be well adapted to the locality where it is to be grown. White Rice and Jap grow excellently in northern Iowa and Nebraska, but can not stand the drought and heat 300 miles south nearly as well as Queen Golden. On the other hand, Queen Golden is too late a variety to mature properly in the region where White Rice and Jap are at their best. Second, a variety should be chosen which can be marketed readily and profitably. If the corn is to be sold locally the type should be grown for which there is a demand or for which a demand can be established because of the excellence of the variety. If the corn is to be shipped it is usually wise to raise the same variety as other growers in the community unless the crop is contracted for in advance or unless special selling arrangements can be made. Local buyers and agents of the large pop-corn companies prefer to handle a single variety in a given region so that it may be shipped and marketed in carload lots.

#### SEED SELECTION

Seed selection is doubly important in pop corn. Pop-corn seed should be selected not only for germination, vigor, and yield, similarly to field-corn seed, but also for popping volume, tenderness, and flavor. Like that of field corn, the adaptation of pop corn is gradually increased by growing it in a given locality over a period of years through the agency of natural selection, which tends to weed out the less adapted variations. It is usually better, therefore, to raise one's own seed year after year or to obtain it from a near-by grower than to get unadapted seed from a distance.

In common with field-corn seed, pop-corn seed should be selected in the field in the fall before the first hard freeze. Take ears only from sturdy, erect stalks which are productive under competition; that is, which bear good ears under conditions of a full stand. Prematurely ripened, diseased, or broken plants should be avoided.

Attention should also be given to adequate husk protection of the ear and the height on the stalk at which the ear is borne. Two or three times as many ears should be gathered as will be needed for planting, to allow for a liberal culling on the basis of germination and of ear and kernel characters. It is of the utmost importance that these ears be quickly and thoroughly dried before sacking or shelling, to insure maximum vigor and germination. Wire hangers, string hangers, lath frames, or any means that will allow the ears to hang without touching one another in a dry, well-ventilated room or shed are satisfactory.

Pop-corn seed carefully handled will germinate well. It is better, however, not to guess on this point, but to test the germination of the seed before planting. The germination can be tested by any of the ordinary methods. One convenient method is the "rag doll," which is described in Farmers' Bulletin 948, a copy of which may be obtained by writing to the United States Department of Agriculture, Washington, D. C.

If a high-grade product is to be maintained, or improvement made, attention should also be paid to the popping quality. Repeated tests have shown that there is a remarkable variability in the popping expansion of individual ears of a variety when they are tested separately. Of 500 random ears taken from a field, the best ones will usually give twice the popping volume of the poorest ears.

It is, of course, impossible for the average grower to ear test individually all his seed by popping. If, however, a few kernels from each ear are split lengthwise with a sharp knife, the kernels of some ears will be found to have much less soft white starch in the center than those of other ears. These ears with least soft starch in the kernels usually will be the ones with the larger popping expansion and therefore most desirable as seed. In addition to the ears with starchy-centered kernels, ears that show evidences of disease or that are badly off type should also be discarded.

#### SOILS, ROTATIONS, AND FERTILIZERS<sup>2</sup>

Pop corn may be grown on any soil that will grow good field corn. Pop-corn production should be restricted in general, however, to the more fertile soils that are not too light and sandy. There it will have opportunity to mature fully and produce a high-grade product.

Crop rotation is even more important where pop corn is grown regularly than it is in field-corn production. The smaller pop-corn plants do not shade out the late weeds, so that pop-corn land soon becomes foul unless rotated. Moreover, land continuously in pop corn becomes less productive and infested with insects and diseases. All of these conditions tend not only to reduce yields but also to increase lodging and to lower the quality of the crop. The exact rotation will differ under different conditions. Probably one of the

<sup>2</sup>The best rotation and the best fertilizer for pop corn depend so largely upon local conditions that discussion here is of necessity very general. The rotations and fertilizers recommended for field-corn production by the different State agricultural experiment stations are suited also for pop-corn production.

most important items, however, is a legume such as sweet clover or red clover preceding the corn crop. Corn followed by oats seeded with sweetclover which is plowed up just before corn planting the following spring is considered a good rotation. Another rotation frequently followed to advantage is corn, corn, oats, and red clover.

Although mineral fertilizers can not take the place of rotations, there is a growing tendency to supplement manure and green manures with commercial fertilizers, particularly superphosphate. One of the principal advantages of a phosphate fertilizer is to hasten development and maturity. Superphosphate may be applied with a fertilizer attachment on the corn planter at the rate of 75 to 150 pounds per acre, or it may be broadcast on the field at the rate of 200 to 300 pounds per acre and worked in before planting. In general, smaller quantities applied in the hill will be as efficient as larger quantities broadcast.

On thin land where the available nitrogen is likely to be low, it often is more desirable to use a complete fertilizer containing nitrogen and some potash in addition to phosphate. Under such conditions a fertilizer containing 4 to 6 per cent of nitrogen, 12 to 16 per cent of phosphoric acid, and possibly also 4 to 6 per cent of potash may be used instead of superphosphate. A fertilizer approximating 4-12-4 used at the rates given above should be sufficient except for the poorest soils. When moisture is likely to be lacking the smaller quantities should be used. Results indicate that mineral fertilizers are not advisable in regions where the average annual rainfall is less than 30 inches, unless the crop is to be irrigated.

#### PLANTING AND CULTIVATING

The usual methods of successful field-corn culture apply also to pop corn with but slight modifications. In the western part of the Corn Belt, particularly in Nebraska and Kansas, where listing is the common method of growing field corn, pop corn also usually is listed. A practice growing in favor in this section is to blank list in the fall, throw in the ridges about two weeks before planting, and at planting time nose out the old furrows with a loose ground lister or with a furrow-opener attachment on the corn planter. (Fig. 4.) The double advantage thus is obtained of killing two crops of early weeds cheaply and of providing a warmer and mellower seed bed than would be available if the ground were freshly listed.

On plowed land pop corn is usually checkrowed (fig. 5) in order to provide for better cultivation. The rows, especially for the smaller varieties, should be somewhat closer together than for field corn. It is a common practice to have the hills 38 to 40 inches apart each way, and frequently rows as close as 36 inches are used. The rate of planting depends on the variety, the character of the soil, the normal rainfall, and other conditions. In general, the optimum rate will provide for from one and one-fourth to two times as many plants per acre as field corn should have in the same locality. In general, from 5 to 6 pounds of seed are required to plant an acre, although this will vary with the size of seed and the rate of planting.

Special plates for planting pop corn can be obtained from most planter manufacturers, or blank plates may be drilled to meet the special requirements of seed size.

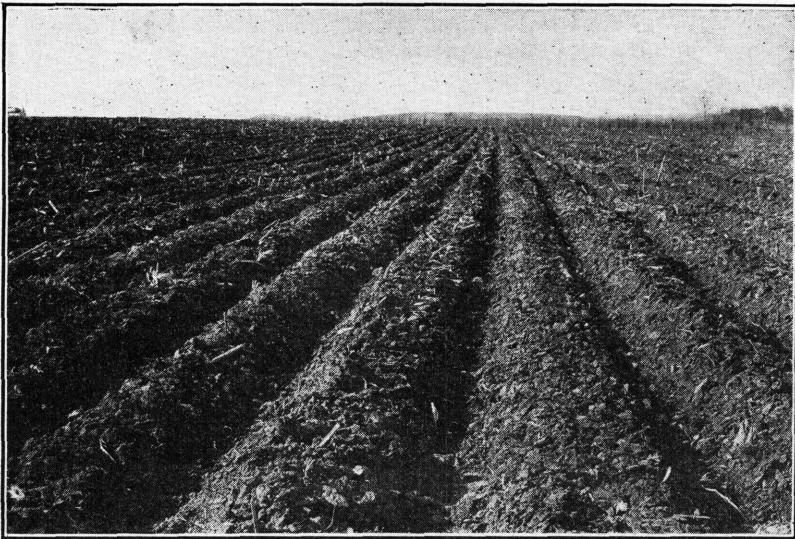


FIGURE 4.—Unplowed field planted with a lister. Unless the ridges are first thrown in and then nosed out, the seed bed frequently will be cold and cloddy

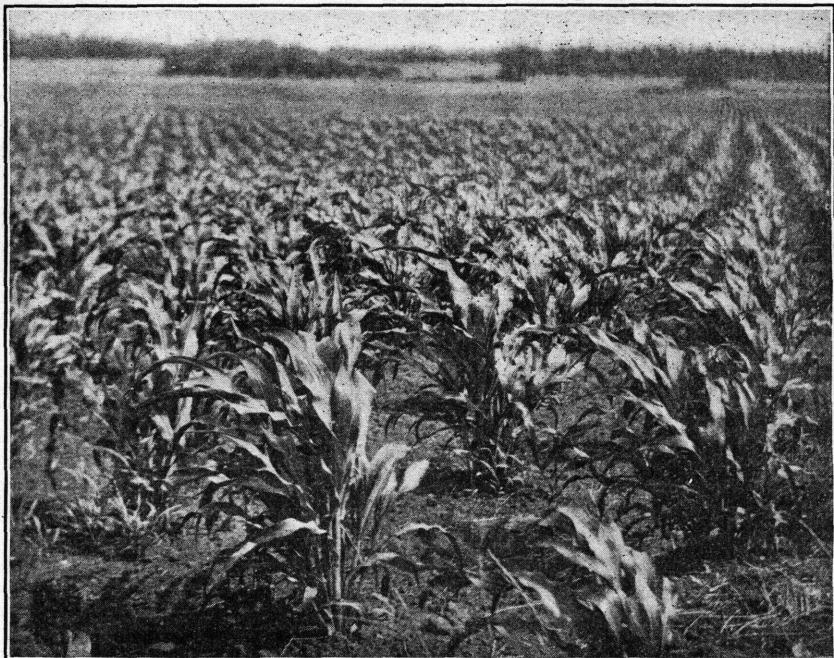


FIGURE 5.—Pop corn planted in checkrows

Corn planters fitted with disk furrow openers (fig. 6) are excellent for planting pop corn on plowed ground. The pop-corn seedlings are small and grow slowly to a size suitable for cultivation. Planting with furrow openers allows the early weeds to be killed with a harrow cheaply and without injuring the small corn plants.

Pop corn may be planted somewhat earlier than field corn, as the hard, vitreous seed is not so easily damaged if the weather happens to turn cold and wet. Early planting is recommended in most localities in order to insure ample time for the crop to mature normally and thoroughly.

The primary purpose of cultivating corn is to control weeds. As has been pointed out, both the yield and quality of pop corn are especially affected by weed growth. The smaller stalks of pop corn can not compete as well with weeds as can those of field corn. The

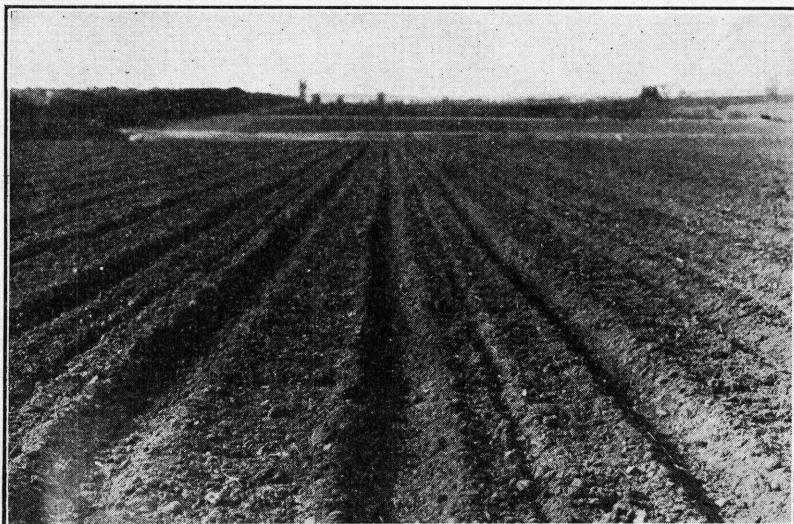


FIGURE 6.—Plowed field planted with a furrow-opener attachment on the planter. Note the opportunity for killing weeds with a harrow without injuring the young corn plants.

three principal practices which help to control weeds are (1) suitable rotations, (2) early and careful preparation of the ground, and (3) thorough cultivation.

Weeds can be killed most cheaply when the field is being prepared for planting. Early working encourages germination of weed seeds and allows them to be killed previously to planting. Nearly as effective and inexpensive are the cultivations given the young corn with harrows, weeders, and similar implements, if they are given frequently enough to prevent the small weeds from becoming established.

Later cultivations can be made satisfactorily with any of the usual cultivators. Cultivations should be frequent enough to control weeds, depending upon the nature of the season. In general, cultivations, particularly the later ones, should be shallow so as not to injure the corn roots unnecessarily. Occasionally, however, it

may be desirable to cultivate deeper. Thus, on heavier soils after a beating rain it is frequently profitable to go deep in the first cultivation and loosen the soil.

#### HARVESTING

Harvesting is one of the most tedious parts of pop-corn production if hand labor is used. (Fig. 7.) Many huskers get so discouraged the first day or two that they refuse to husk pop corn even though the rate per bushel is enough greater than that for field corn so that they receive as much per day as for field corn. Jap corn usually is snapped rather than husked.

During the last few years the improvement of mechanical pickers has made them increasingly popular for pop corn. (Fig. 8.) In some localities of commercial production 75 per cent or more of the



FIGURE 7.—Husking pop corn by hand. The small box on the side of the wagon is for unusually fine ears to be saved for seed

pop corn now is harvested with pickers, the farmers with machines frequently doing considerable custom work for neighbors. Several makes of machines are giving satisfactory service. Most of them are of the single-row type, although a few 2-row pickers also are in use. The first cost of these machines is rather high, ranging from \$300 to \$700, but if the owner and his neighbors can furnish sufficient acreage to keep the picker busy, the cost per bushel should be less than for hand husking.

An important advantage of the picker is the fact that the crop can be harvested quickly before it deteriorates by weathering. Pickers will frequently leave 200 to 300 pounds in the field where corn is badly down; but where it is standing well a good picker should not leave more than 50 pounds to the acre. Little trouble ordinarily is experienced in shelling when the stalks are dry and brittle.

## STORING

Pop corn seldom is dry enough to pop well when harvested. Cribs must provide adequate ventilation to cure the corn to optimum moisture content before shelling. As pop corn is used as a human

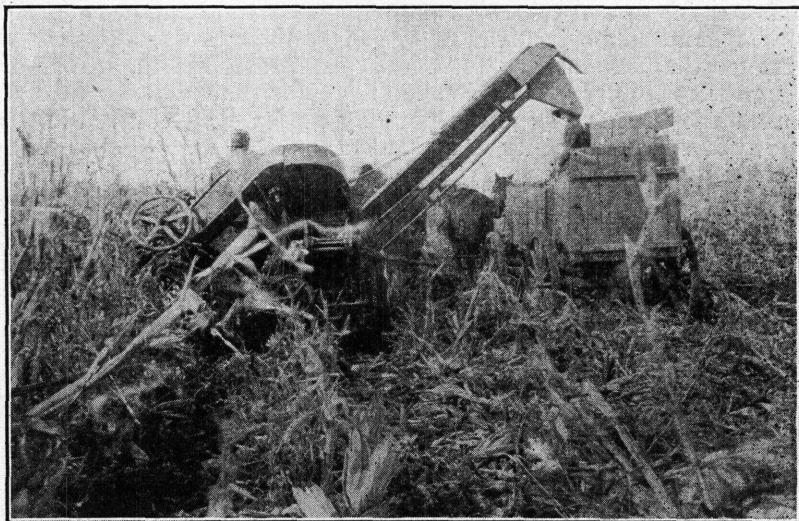


FIGURE 8.—Husking pop corn with a mechanical picker

food, special precautions also should be taken to prevent damage during storage by rats and mice and by heating. (Fig. 9.)

The precautions necessary in a given locality will depend upon the usual moisture content of the corn at harvest and upon the weather which usually follows harvest. In Iowa, for example, the crop

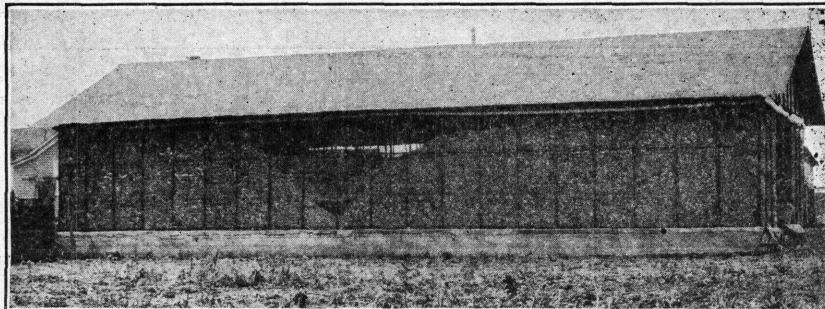


FIGURE 9.—A rat and mouse proof crib having a concrete foundation, an iron frame with wire netting, and storm curtains on the sides and at the ends

almost always contains considerable excess moisture when husked, and the succeeding months are so unfavorable for drying that it does not reach a good popping condition until the following May or June. Here, cribs constructed to allow unusually good ventilation are the rule. Crib widths of 4 feet ordinarily are considered satisfactory

under these conditions. If wider cribs are used, temporary partitions or air tunnels frequently are added, as shown in Figure 10, to provide the ventilation needed for proper curing. The storage cribs of the large pop-corn companies in centers of commercial production are models of satisfactory design and sound construction.

In Kansas, on the other hand, early planted pop corn usually is well cured when husked. In addition, the autumns are comparatively late and dry, so that corn frequently is in popping condition

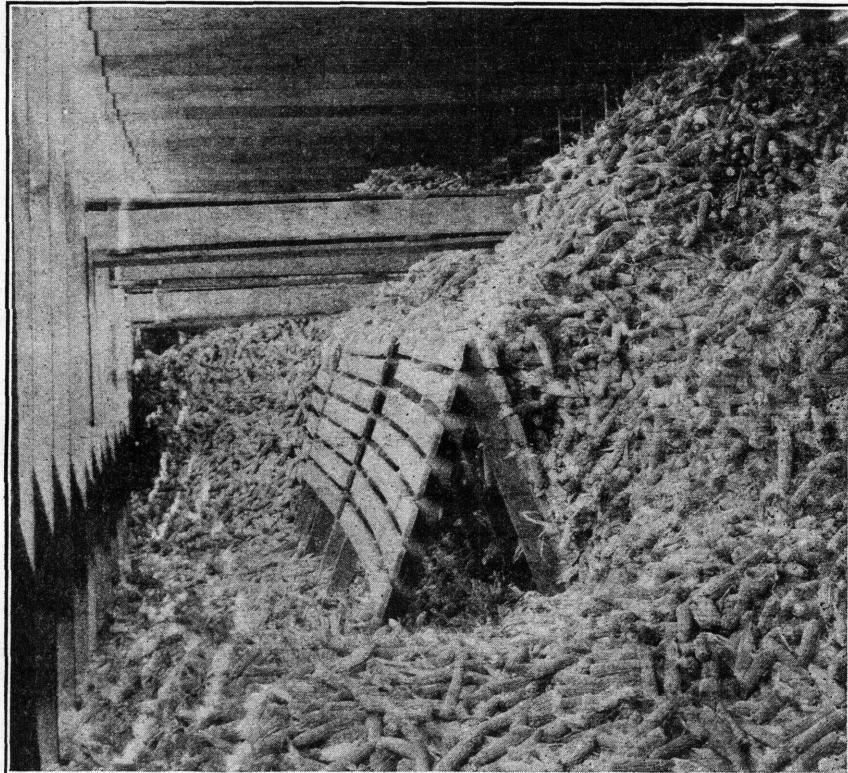


FIGURE 10.—Movable A-shaped ventilators in a pop-corn crib. These should extend the entire length of the crib to provide a free circulation of air

by Thanksgiving Day. As a result of these factors, much less attention to pop-corn storage is necessary in order to produce a well-cured product.

Pop corn should not be shelled until it has reached the optimum moisture content for popping (about 13 to 14 per cent). Moreover, dealers prefer not to shell until very shortly before the corn is to be used because of the greater danger of the shelled corn going out of condition. As a result, practically all bulk pop corn is stored and shipped on the ear. (Fig. 11.) If protected from insects and rodents, ear corn may be stored three or four years without apparent deterioration in popping quality.

## MARKETING

As is the case with most specialized crops, marketing is an important factor in determining whether or not pop corn is to return a profit. Three main outlets are open and will be discussed sepa-

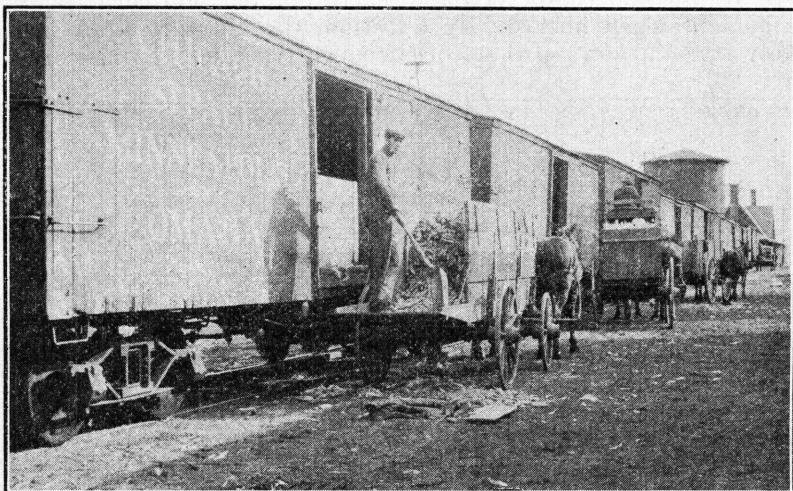


FIGURE 11.—Loading pop corn for shipment

rately; namely, local sales, contracted acreage, and selling on the open market.

Local or specialized sales may be utilized particularly well by those growers who live near cities and where little pop corn is

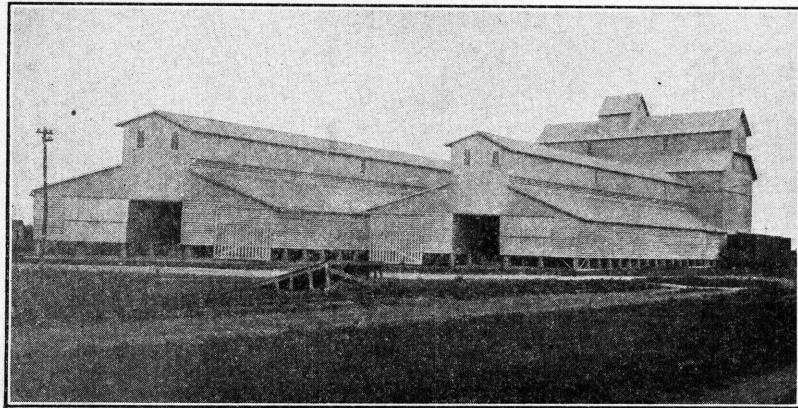


FIGURE 12.—Pop-corn elevator and storage cribs in Nebraska

raised. A product of high and uniform quality with a little judicious advertising frequently will find a ready market in a near-by city. It may even stimulate the pop-corn consumption and so develop a larger demand. One grower in Oregon, who has built up a reputation for quality, retails his entire crop each year to cus-

tomers who call for it at the farm. Essentials for success in making local sales include (1) a high-quality variety, (2) proper moisture content, (3) sorting out diseased and moldy ears before shelling, (4) careful shelling and cleaning, and (5) clean, attractive sacks or packages. Too frequently growers are careless about one or more of the above points, so that retail customers of direct sales are not fully satisfied.

Much of the commercial pop-corn acreage is always contracted for in advance by the large pop-corn companies and seed houses. This tends to stabilize the market and to guarantee a reasonable profit to both grower and jobber. The contract usually calls for the entire crop to be delivered in the ear to some designated crib or elevator (fig. 12) at a fixed price per pound. The seed from which the crop is to be grown generally is furnished by the company as part of the contract.

The grower who does not contract his crop in advance assumes the risks of fluctuations in price. If the crop happens to be short or if demand increases, bringing higher prices, he may make a substantial profit. On the other hand, if a considerable surplus is in sight at harvest time, the free-lance grower will find buyers very indifferent about taking noncontracted corn, with sales at distress prices the only outlet, if he is forced to sell.

The pop-corn acreage can be expanded very easily to an extent where production becomes unprofitable. Only a year or two of relatively high pop-corn prices or of relatively low field-corn prices, or both, will cause the regular growers to increase their acreage. In addition, a host of new growers are added, attracted by stories of the large profits of their friends and neighbors. The results are over-production, low prices, and losses.

The large pop-corn companies keep in close touch with the current acreage and condition of the crop, as well as with the probable market demand and amount of carry-over, and regulate their prices for cash corn and their bids for contracted acreage accordingly. By keeping informed on fluctuations in current cash prices, and particularly on the prices for the product of acreages contracted for the coming season, the small grower can keep somewhat in touch with market conditions and make his plans accordingly. It is usually unwise, especially for the amateur pop-corn grower, to plant a large acreage immediately following a year of high prices. The chances are that many others will do the same thing, with the result that the market will be flooded and that there will be a disastrous drop in prices.

Pop corn differs greatly in its popping expansion; that is, the volume ratio of the popped to the unpopped corn. For instance, if a cup full of corn will pop out 17 cups full, it is said to have an expansion of 17 volumes. Glass graduates containing two popped and unpopped samples illustrating a difference in expansibility are shown in Figure 13. Unfortunately, a method for making the test has never been thoroughly standardized, and there is frequently a disagreement between two tests, due to the size and shape of the measures, the degree to which the popped sample is packed before the reading is taken, etc.

Popping expansion is influenced by the innate excellence of the variety or strain, its opportunity for complete and normal maturity, and the moisture content of the corn at the time of popping. There are no standard grades, but in general, for bulk samples of retail corn, expansions of under 15 volumes may be considered poor, those

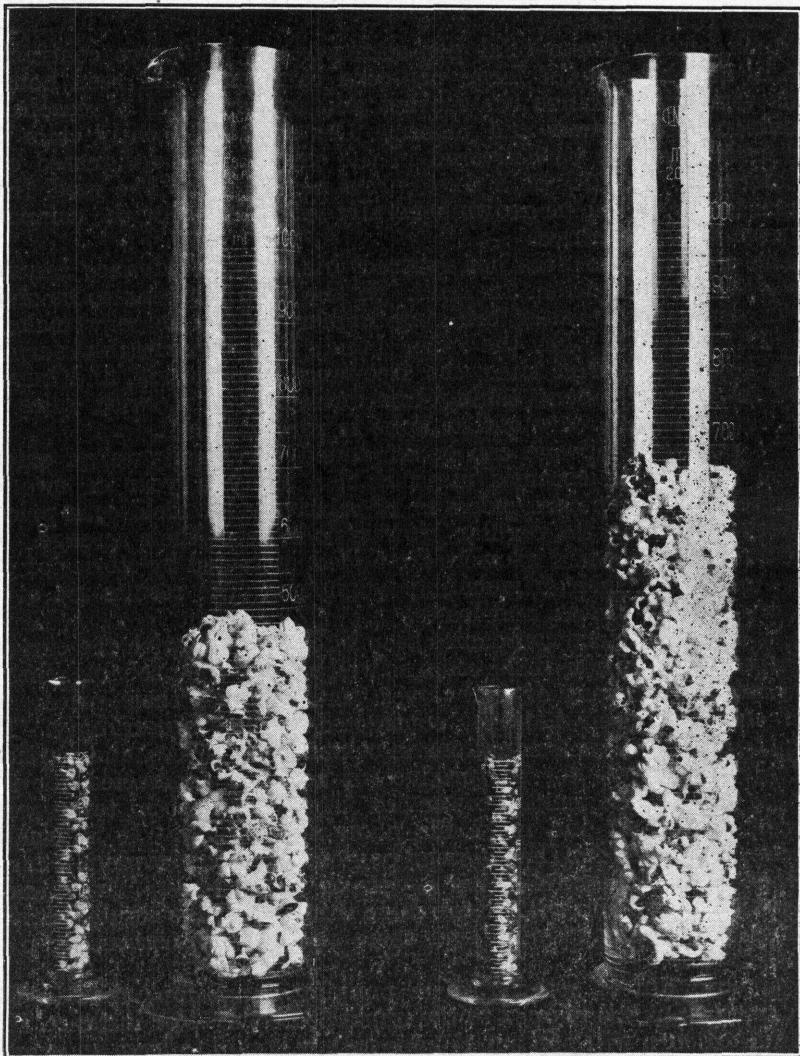


FIGURE 13.—Two samples of pop corn before and after popping, showing differences in expansibility

of 15 to 19 volumes fair, those of 20 to 24 volumes good, and those of 25 or more volumes excellent. Although expansion usually is considered in marketing pop corn, it should be given even more weight in determining price. Some system of premiums for high-popping samples similar to the premiums paid for high-protein wheat could easily be worked out. The bulk of the popped corn, the end product,

varies with the expansion. Even more important, the tenderness and quality of the best popping corns usually are superior, making a double advantage for the samples with high expansion.

#### INSECTS AND DISEASES

The insects and diseases that injure field corn also attack pop corn. The more important insects attacking pop corn in the field are corn earworms, cutworms, army worms, rootworms, and the like. The grain weevil and the Angoumois grain moth are the more important pests of stored pop corn, and in the Southern States they may cause damage before the ears are harvested. Crop rotation and clean farming will help in reducing the amount of infestation and damage by many of the field insects. Specific measures for reducing damage by others are given in bulletins which may be had upon application to the United States Department of Agriculture.

It should be pointed out, however, that damage to the grain such as that caused by the corn earworm, the weevils, and the grain moth is more serious in pop corn because of its use for human food. Except for local markets, areas where such damage is usual and severe can not hope to compete in pop-corn production with areas where such damage is negligible.

The more important diseases affecting pop corn are smut and the root, stalk, and ear rots. Selecting seed from disease-free stalks will promote the development of strains more or less resistant to diseases. Special selection of seed on the basis of germination tests should be used in areas where the various rot diseases are prevalent.<sup>3</sup> Because of hard endosperm pop corn is not as susceptible to these diseases as dent corn. However, injury is more serious when it occurs, because it reduces the quality of the corn and in pop corn quality is of greater importance.

#### DOES IT PAY TO GROW POP CORN?

The frequently asked question, "Does it pay to grow pop corn?" can not be answered simply by "yes" or "no." The demand for pop corn is rather constant, and the supply usually just about meets this demand at a reasonable profit to the producer. Any material increase in supply tends to decrease the price to a level where production is unprofitable. In areas of regular commercial production pop corn probably pays the successful grower about as well as or a little better than field corn. In areas where pop corn is not produced regularly in commercial quantities the difficulties of marketing advantageously reduce the chances of profitable production.

Profit in producing pop corn on a smaller scale to meet local demand depends upon the ability of the individual as a merchant as well as upon his ability as a producer. He must, of course, produce a crop of good quality economically. The development of direct sales in competition with others, however, will depend largely upon the care with which the product is first stored and then prepared for market so that it will retain its quality and be attractive.

<sup>3</sup> See Farmers' Bulletin 1176, Control of the Root, Stalk, and Ear Rot Diseases of Corn.

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